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Toward Measuring Empathy in Virtual Reality

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Abstract
While VR is often described as an empathy-inducing medium, it is difficult to link specific features of a VR experience to empathy outcomes. This is due in large part to the challenges of measuring empathy constructs, and the difficulty of capturing the subjective emotional experience of a player in VR. In response, the authors propose a lightweight, inexpensive framework that researchers can use to easily establish a VR testing environment and begin gathering data on the subjective empathic response of users in VR. The authors also propose future research needed to expand, modify, and validate the proposed user-testing protocol.

Author Keywords
Virtual Reality, research methods, empathy

ACM Classification Keywords
H.5.1 [Information interfaces and presentation]: Multimedia Information Systems; H.5.3 [Information interfaces and presentation]: Group and Organization Interfaces; K.8.0 [Personal Computing]: Games

Introduction
With the advent of consumer Virtual Reality (VR) products, the idea that VR is the ultimate "empathy machine" is gaining popularity [25]. However, these claims are more reflective of the hopes of VR content creators and their excite-

ment about the medium than they are of the current state of scholarship about empathy and VR.

A critical step for developing empathic VR is to be able to study empathy in VR contexts. However, existing methodologies for measuring empathy fall short when applied to VR. For example, empathy self-report methods can be unreliable or burdensome when compounded with the cognitive overload of a VR experience, while adding biometric monitoring can be expensive [16, 33].

We set out to create a lightweight approach to measuring empathy in VR experiences, building off of existing research on empathy measures in VR [1, 2, 3, 13, 20, 23, 27, 28]. Our work serves as a jumping off point for researchers interested in understanding the affective power of VR experiences, and for those interested in a user testing method that can be deployed in the field quickly and inexpensively.

The Challenges of Studying Empathy in VR

Commonly, empathy is understood as the ability to understand another's emotions. In the psychological sciences, however, there is a distinction between two primary types of empathy–cognitive empathy and emotional empathy. Cognitive empathy is the ability to consciously understand how and why someone feels what they feel (often called "perspective taking") [6]. It is useful when discerning another person's intent, strategy, or thought process [15]. Emotional empathy, on the other hand, is an embodied reaction, reflecting one's ability to respond to another's emotions [6]. It is useful when building a team, understanding the strengths of others, and fortifying interpersonal relationships [15].

Despite these differences, both types of empathy are skills. People have different baseline aptitudes and abilities with each, and empathy can be trained and strengthened with practice [6, 19]. Independent of skill level, empathy can be stimulated by intense emotion, with larger affective intensity leading to higher empathy [12]. There is evidence that carrying out simulated physical acts, more so than imagining them, has the ability to influence emotional states and induce empathy [1, 18, 34]. Empathy can also be attenuated based on the observer's motivation to empathize, the emotion the observed person is feeling, and the familiarity the observer has with the emotion with which they are to empathize. For example, pleasant, familiar emotions induce more empathy than unpleasant, alien ones [11].

VR allows users to take on new perspectives while providing the immersion necessary for embodied thinking, a key component of empathy [6, 22, 30]. Player immersion has been linked to empathy games generally, but is especially relevant to studying the effects of VR on empathy [8, 17]. However, observing, testing for, and measuring empathy as induced by a VR experience is challenging. VR is experienced in the first person, which makes it difficult for observers to capture, especially when the player may not be consciously aware of what they are experiencing. Additionally, VR experiences are influenced by a range of factors unique to the medium, including immersion, embodiment and presence–all of which are notoriously difficult to capture in their own right [22, 24, 8, 20]. Researchers have measured the empathy effects of experiences in mixed and virtual reality through in-depth interviews on the player's ability to elaborate on a character's inner-life [20], and through surveys measuring perspective taking[1]. However, we have yet to see a unified, VR-specific method for capturing data on user emotion and perspective taking [7, 10].

Existing Measurement Methodologies

Researchers studying cognitive and emotional empathy have traditionally collected data through self-report and ob-

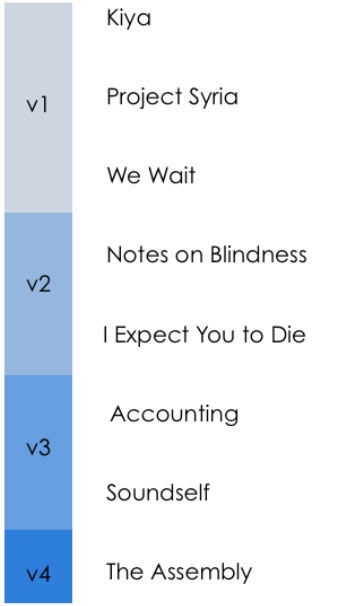

Figure 1: VR experiences tested, matched to iterations on the protocol.

servation. [14]. Researchers have tried to capture user data about VR experiences through retrospective self-report, momentary self-report, and physiological tracking. However, existing methods for measuring empathy and for capturing user data about VR experiences do not neatly align.

Empathy Measures

The most common tools for measuring empathy are self-assessment surveys [14]. A small number of validated measures capture both emotional and cognitive empathy factors, such as the Empathy Quotient (EQ) [21]. Other measures focus exclusively on cognitive or exclusively on emotional empathy, and often capture mediating concepts. For example, one proxy for cognitive empathy is whether the user's sense of self is merged or distinct with an empathy target, which can be captured by the Inclusion of Other in the Self (IOS) scale [4, 14]. While these methods provide standardized data for researchers, because they rely on self-report, it can be difficult to judge whether the reported responses hold up in real life scenarios [14].

In contrast, observational methods for measuring empathy (for example, ratings and assessment of interactions with therapists [14], or with research confederates [7]) are rooted in real life scenarios. However, observational methods lack the standardization of surveys, even when comparing the same person across testing sessions [7]. This challenge suggests an opportunity for VR to contribute to empathy research, as VR allows researchers to tightly control realistic virtual environments.

Collecting First-Person Experience Data in VR

Existing methods for capturing subjective user data about VR experiences include retrospective self-report, momentary self-report, and physiological tracking. With retrospective self-report, users answer surveys or participate in interviews after the end of a VR experience. Existing self-report measures mostly focus on core VR concepts, such as presence and immersion [16, 17], rather than on the range and intensity of player's emotions. Because self-report measures are administered after the experience, they are vulnerable to memory decay, bias, and distortion [33]. However, momentary self-report techniques such as the think-aloud method [26], real-time sliders [16], and counters [30], can distract from the VR experience, prevent users from engaging with the VR console controls, and be difficult to employ because users may not be consciously aware of the elements they are supposed to be reporting [16]. While physiological tracking techniques that measure arousal through skin conductance, heart rate, and reflex response times, promise a less biased way to measure user response compared to self-report, results can be hard to normalize and interpret across users with different baselines [16]. Beyond this, the hardware and setup time necessary to implement physiological tracking is prohibitive to many researchers.

Researchers studying empathy have struggled to find methods that are standardized, like self-report surveys; that have ecological validity, like observational studies; and that can be implemented in VR. We believe there is an opportunity to develop new methods for capturing a user's subjective emotional experience in a time-linked way, so that specific game experiences can be connected to emotions. This method should allow unobtrusive observation of a first person experience. Because many users are new to VR, the method should account for player familiarity and comfort with the technology. Given the high cost of external tracking hardware, this method should be lightweight so as to be accessible to more researchers. Lastly, this method should address cognitive and emotional empathy as distinct factors, allowing for integration of existing measures relevant to empathy, such as the EQ [5]. and IOS scale [4].

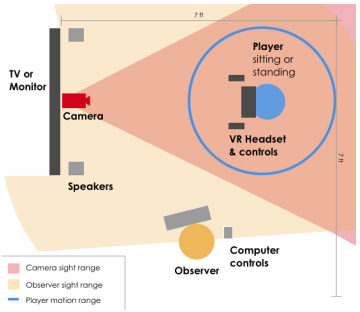

Figure 2: The layout of the room during playtesting. The player stands in the center of a cleared area with the VR headset. The observers sit just outside the area with a view of both the player and the video stream from the headset, taking notes and controlling the recording equipment. A single camera captures the player from straight on.

Methods

To explore methods for capturing empathic responses to VR content, our team playtested multiple VR experiences and iteratively developed protocols for data collection [9]. We generated a list of 34 VR experiences that made claims about inducing empathy by pulling from academic journals and popular articles on VR experiences, and searching the VR game stores SteamVR and Rift Experiences. However, many VR experiences described in both academic journals and blogs are not publicly available through VR game stores. From the publicly available experiences, we selected eight experiences, aiming for a wide variance of subject matter and VR experience styles, which included 360-degree documentary video, 3D scenario reconstruction, and interactive fictional narrative. A complete list of the experiences used in testing can be found in Figure 1.

In each of eight playtest sessions, a member of the research team who had never played the VR experience being tested was assigned to be the "player." Additional researchers, or "observers," managed the video and audio data collection, took notes of their observations, and administered the interview portions of the protocol. Rotating the player role among members of the research team allowed us to consider both the subjective, experiential aspects of empathy-related data collection in VR, and the usefulness of the data collected to researchers. At the end of each session, the team collaboratively debriefed about their observations and experiences, reviewed the data collected, identified gaps in data collection, and made proposals to iterate the protocol. To develop the insights reported in this paper, the team reviewed all data collected from the project, including the multiple versions of the data collection protocol, the field notes generated from each session, and the notes from each debriefing session. All team members reached agreement on the concepts presented.

Insights for Protocol Development

Observing a First Person Experience

A player's subjective experience in VR is shaped by their interactions within the virtual experience, including where they choose to look. While in the VR experience, players often have physical or verbal reactions to the content of which they are unaware. For this reason, the player's body language can provide an important complement to self-reported subjective data. Our iterative protocol development revealed that it was valuable for researchers to be able to observe the player's physical reactions while simultaneously seeing what they were experiencing in VR, so that they could take effective field notes. Additionally, recording the VR headset feed provided a useful prompt for player interviews as well as an artifact for later analysis.

VR platforms, like Oculus Rift and SteamVR, automatically display a video feed of the player's view on a connected screen, and can simultaneously display a webcam capture of the player. However, VR platforms do not natively support piping the audio of the VR experience into the room. We used Voicemeeter to ensure that the VR audio went through both the headset and the computer's speakers [32]. Video capture software such as OBS Studio can then record the audio, the screen view, and the webcam [31].

It is critical for the researcher to be able to observe both the screen and the player without interfering with data capture. One layout that accomplishes this goal can be found in Figure 2, where the observer sits at the edge of the space, between the player and the screen displaying the VR headset's video feed. From this position the observer can note the player's posture, facial expressions, verbalizations, and other unexpected player behavior, as well as identifying what is happening in the VR experience at the time.

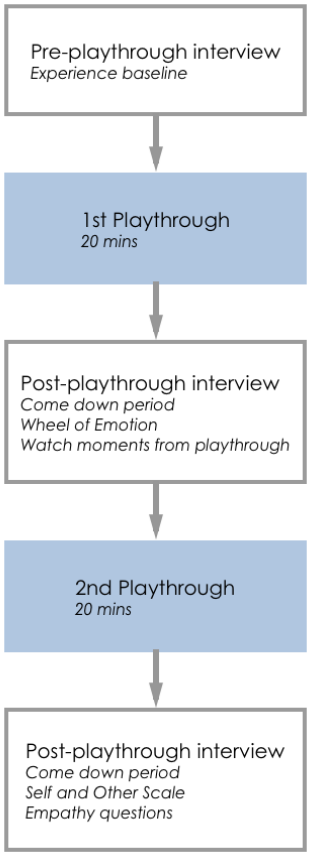

Figure 3: The final version of our protocol included at least two playthroughs of the VR experience, and three interviews with supporting material.

Calibrating Player Experience Measures

Through iterative testing, it became apparent that there are a number of ways relevant empathy measures can be skewed during a VR experience. The player's familiarity with VR affected their emotional experience due to responses like frustration when learning how to use the controls. The highly immersive nature of VR can lead to information overload, making it difficult for the player to process information during the experience and for the observer to ask detailed questions of the player after the experience. We recommend assessing the player's experience level with VR, allowing them time to process after each playthrough, and ensuring their comfort with the material.

Interviewing players about their experience level with VR before interacting with the experience accomplishes two goals. First, it helps the observer establish a baseline for their observations about the player's comfort level or frustrations during play. Second, it helps the player reflect on their own abilities and take frustration with the controls into account when reporting data.

Our original protocol also included a structured post-play interview. However, in our iterative testing, we found that players repeatedly diverged from the interview script to touch on the most immediately memorable points in the experience. Players were using the post-game interview to process the highly immersive experience, which made it difficult to collect other types of data. In response, we inserted open-ended questions to start to identify key moments to delve into in more detail later in the interview. This decompression time also exposed the player's feelings of embodiment as they adjust back to the physical world, often commenting on their awareness of their hands or their change in height from VR to the physical world.

Through iterative playtests, we saw that players had trouble taking in both the narrative and the mechanics of the game in a single playthrough. Empathic responses are linked, through immersion, to engagement with a rich narrative world [8], and we found that players often reported higher empathetic responses after having played an experience multiple times. We therefore recommend that researchers expose players to empathy-inducing VR experiences at least twice. The player spends the first playthrough familiarizing themselves with the experience and the controls; subsequent playthroughs allow the player to actively notice the details of the experience-sounds, interaction with objects, characters-and engage with the narrative world.

Subjective Data Capture

Measures such as emotional response or sense of self are difficult to communicate because of the wide range of possible interpretations across participants, but they are important to empathy measures. For this reason, we employed two tools as communication aids and to standardize responses across players. The first set of tools includes a wheel of emotions (Figure 4) to help players identify emotions, and video playback to situate an emotional response in a particular moment in the experience. The wheel provides a comprehensive list of emotions and standardizes the data collected [29]. When players identify emotions the researcher prompts them to identify specific moments of play that they associate with the feeling.

The player and observer then watch the indicated emotional moments using the recorded video feed capture, allowing the player and observer to have a shared language about the VR experience and a targeted discussion about the emotional experience. As the researcher plays back the excerpt of the experience, the player is asked to recall their initial thoughts and emotions, much like a think-aloud. The researcher then asks follow up questions to probe on the

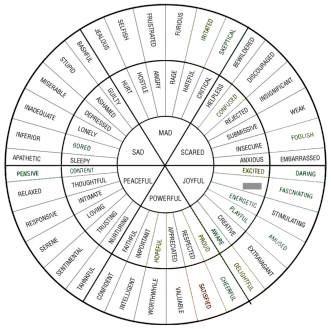

Figure 4: The Wheel of Emotions.

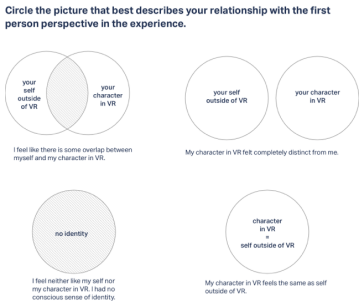
Circle the picture that best describes your relationship with the first person perspective in the experience.
your self outside of VR
your character in VR
I feel like there is some overlap between myself and my character in VR.
your self outside of VR
your character in VR
My character in VR felt completely distinct from me.
no identity
I feel neither like my self nor my character in VR. I had no conscious sense of identity.
character in VR = self outside of VR
My character in VR feels the same as self outside of VR.

Figure 5: The VR-adapted Other in the Self scale.

player further to discover their responses to specific interactions, narrative events, and characters, including feelings toward the character the player inhabited, if applicable. The process of identifying emotions with the wheel and then situating them in moments of play, also helps the researcher separate emotional responses related to learning the interface from feelings induced by the content of the experience.

While the wheel of emotions helps us understand emotional empathy, the spontaneous feeling of oneness with another's emotions, a second set of tools is needed to understand cognitive empathy, which is characterized by understanding another's perspective while also maintaining a distinct sense of self [6]. We employed a VR-adapted Other in the Self Scale [4] to help players articulate how they related to the character they inhabited and others that they encountered.

After revisiting the video recording in the interview after the second playthrough, the player fills out our VR-adapted Other in the Self Scale (Figure 5), in order to articulate their sense of separation from or overlap with the characters they inhabited or interacted with. The observer also asks a series of questions about the player's sense of identity and feelings towards other characters throughout the experience, such as the characteristics of who the player was in the experience, a description of what the other characters experienced, and how the player felt watching other characters' experiences. Here we are looking for correlations between the detail with which the player can recount what other characters felt and what they felt themselves.

Accessibility and Cost

By focusing our research on low-cost, accessible methods, our protocol has a low barrier for use by researchers of all backgrounds and means. Provided the researcher has access to a VR headset and compatible PC, the materials and methods employed in the protocol are low-cost (webcam, speakers) or free (Voicemeeter, OBS Studio, wheel of emotions, and Other in the Self scale).

Future Work

We have found that much of the rhetoric around the potential of VR and empathy is based on conjecture and the novelty of the medium, rather than on studies of specific empathy constructs in the context of a VR experience. We offer these insights and our sample protocol to support lightweight data collection that emphasizes the first-person emotional qualities of VR, and to work toward a future evaluative framework for understanding VR and empathy.

At this stage, our work implies, but does not validate, methods for collecting empathy-relevant data in VR experiences. A critical next step would be to validate our insights. In particular, we would like to test how well the wheel of emotions is able to capture a comprehensive inventory of emotions, and how closely the Other in the Self scale correlates with existing empathy measures like the Empathy Quotient when used in VR contexts. Additionally, future versions of this protocol will likely contain a method of capturing user empathy baselines in order to better determine the empathy effect. By validating the protocol using subjects outside this research group, we will be able to further iterate and refine our procedure. With validated empathy measurements, a baseline empathy capture, and a more fine-tuned momentary tracking, we see the potential of this protocol to provide the ability to measure player empathy resulting from features of VR experiences for experience designers and researchers from all fields.

REFERENCES

1. Sun Joo Ahn, Amanda Minh Tran Le, and Jeremy Bailenson. 2013. The effect of embodied experiences

on self-other merging, attitude, and helping behavior. *Media Psychology* 16, 1 (2013), 7–38.

2. Sun Joo (Grace) Ahn, Jeremy N. Bailenson, and Dooyeon Park. 2014. Short- and Long-term Effects of Embodied Experiences in Immersive Virtual Environments on Environmental Locus of Control and Behavior. *Comput. Hum. Behav.* 39, C (Sept. 2014), 235–245. DOI: http://dx.doi.org/10.1016/j.chb.2014.07.025
3. Sun Joo Grace Ahn, Joshua Bostick, Elise Ogle, Kristine L Nowak, Kara T McGillicuddy, and Jeremy N Bailenson. 2016. Experiencing nature: Embodying animals in immersive virtual environments increases inclusion of nature in self and involvement with nature. *Journal of Computer-Mediated Communication* 21, 6 (2016), 399–419.
4. Arthur Aron, Elaine N Aron, and Danny Smollan. 1992. Inclusion of Other in the Self Scale and the structure of interpersonal closeness. *Journal of personality and social psychology* 63, 4 (1992), 596.
5. Simon Baron-Cohen and Sally Wheelwright. 2004. The empathy quotient: an investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *Journal of autism and developmental disorders* 34, 2 (April 2004), 163–175. http://view.ncbi.nlm.nih.gov/pubmed/15162935
6. Liz Owens Boltz, Danah Henriksen, Punya Mishra, Deep-Play Research Group, and others. 2015. Rethinking Technology & Creativity in the 21st Century: Empathy through Gaming-Perspective Taking in a Complex World. *TechTrends* 59, 6 (2015), 3–8.
7. Dario Bombari, Marianne Schmid Mast, Elena Canadas, and Manuel Bachmann. 2015. Studying social interactions through immersive virtual environment technology: virtues, pitfalls, and future challenges. *Frontiers in Psychology* 6 (2015), 869. DOI:http://dx.doi.org/10.3389/fpsyg.2015.00869
8. Kevin Brooks. 2003. There is nothing virtual about immersion: Narrative immersion for VR and other interfaces. *alumni. media. mit. edu/˜ brooks/storybiz/immersiveNotVirtual. pdf (accessed May 2007)* (2003).
9. Judeth Oden Choi, Jodi Forlizzi, Michael Christel, Rachel Moeller, MacKenzie Bates, and Jessica Hammer. 2016. Playtesting with a Purpose. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*. ACM, 254–265.
10. Julia Diemer, Georg W Alpers, Henrik M Peperkorn, Youssef Shiban, and Andreas Mühlberger. 2015. The impact of perception and presence on emotional reactions: a review of research in virtual reality. *Frontiers in psychology* 6 (2015), 26.
11. Changming Duan. 2000. Being Empathic: The Role of Motivation to Empathize and the Nature of Target Emotions. *Motivation and Emotion* 24, 1 (2000), 29–49. DOI:http://dx.doi.org/10.1023/A:1005587525609
12. Elisabeth Engelberg and Lennart SjÃűberg. 2004. Emotional intelligence, affect intensity, and social adjustment. *Personality and Individual Differences* 37, 3 (2004), 533 – 542. DOI: http://dx.doi.org/10.1016/j.paid.2003.09.024

13. Hunter Gehlbach, Geoff Marietta, Aaron M. King, Cody Karutz, Jeremy N. Bailenson, and Chris Dede. 2015. Many ways to walk a mile in another's moccasins: Type of social perspective taking and its effect on negotiation outcomes. *Computers in Human Behavior* 52 (2015), 523 – 532. DOI:http://dx.doi.org/https://doi.org/10.1016/j.chb.2014.12.035

14. Karen E. Gerdes, Elizabeth A. Segal, and Cynthia A. Lietz. 2010. Conceptualising and Measuring Empathy. *The British Journal of Social Work* 40, 7 (Oct 01 2010), 2326–2343. https://search-proquest-com.proxy.library.cmu.edu/docview/818793491?accountid=9902

15. Debra Gilin, William W. Maddux, Jordan Carpenter, and Adam D. Galinsky. 2013. When to Use Your Head and When to Use Your Heart. *Personality and Social Psychology Bulletin* 39, 1 (2013), 3–16. DOI: http://dx.doi.org/10.1177/0146167212465320 PMID: 23150199.

16. WA IJsselsteijn and H De Ridder. 1998. Measuring temporal variations in presence. In *Presence in Shared Virtual Environments Workshop, University College, London*. 10–11.

17. Charlene Jennett, Anna L Cox, Paul Cairns, Samira Dhoparee, Andrew Epps, Tim Tijs, and Alison Walton. 2008. Measuring and defining the experience of immersion in games. *International journal of human-computer studies* 66, 9 (2008), 641–661.

18. Karine Jospe, Agnes FlÃűel, and Michal Lavidor. 2017. The role of embodiment and individual empathy levels in gesture comprehension. *Experimental Psychology* 64, 1 (2017), 56 – 64. http://search.ebscohost.com.proxy.library.cmu.edu/login.aspx?direct=true&db=pdh&AN=2017-08398-007&site=ehost-live

19. Zeinab Khanjani, Elnaz Mosanezhad Jeddi, Issa Hekmati, Saeede Khalilzade, Mahin Etemadi Nia, Morteza Andalib, and Parvaneh Ashrafian. 2015. Comparison of Cognitive Empathy, Emotional Empathy, and Social Functioning in Different Age Groups. *Australian Psychologist* 50, 1 (2015), 80–85. DOI: http://dx.doi.org/10.1111/ap.12099

20. Martijn JL Kors, Gabriele Ferri, Erik D van der Spek, Cas Ketel, and Ben AM Schouten. 2016. A Breathtaking Journey.: On the Design of an Empathy-Arousing Mixed-Reality Game. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*. ACM, 91–104.

21. E. J. Lawrence, P. Shaw, D. Baker, S. Baron-Cohen, and A. S. David. 2004. Measuring empathy: Reliability and validity of the empathy quotient. *Psychological medicine* 34, 5 (07 2004), 911–919. https://search-proquest-com.proxy.library.cmu.edu/docview/204514684?accountid=9902

22. Matthew R Longo, Friederike Schüür, Marjolein PM Kammers, Manos Tsakiris, and Patrick Haggard. 2008. What is embodiment? A psychometric approach. *Cognition* 107, 3 (2008), 978–998.

23. Geoff Marietta, Julianne Viola, Nneka Ibekwe, Jessica Claremon, and Hunter Gehlbach. 2014. Improving relationships through virtual environments: How seeing the world through victims' eyes may prevent bullying. *Work. Pap., Grad. Sch. Educ., Harvard Univ. Article Location* (2014).

24. Alison McMahan. 2003. Immersion, engagement and presence. *The video game theory reader* 67 (2003), 86.

25. Chris Milk. 2015. Chris Milk: How Virtual Reality Can Create the Ultimate Empathy Machine. TED Talks.

26. Jakob Nielsen. 1994. *Usability engineering*. Elsevier.

27. Soo Youn Oh, Jeremy Bailenson, Erika Weisz, and Jamil Zaki. 2016. Virtually old: Embodied perspective taking and the reduction of ageism under threat. *Computers in Human Behavior* 60 (2016), 398 – 410. DOI:http://dx.doi.org/10.1016/j.chb.2016.02.007

28. David L Penn, James D Ivory, Abigail Judge, and others. 2010. The virtual doppelganger: Effects of a virtual reality simulator on perceptions of schizophrenia. *The Journal of nervous and mental disease* 198, 6 (2010), 437–443.

29. Robert Plutchik. 1980. A general psychoevolutionary theory of emotion. *Theories of emotion* 1, 3-31 (1980), 4.

30. Martijn J Schuemie, Peter Van Der Straaten, Merel Krijn, and Charles APG Van Der Mast. 2001. Research on presence in virtual reality: A survey. *CyberPsychology & Behavior* 4, 2 (2001), 183–201.

31. Open Broadcaster Software. 2017a. OBS Studio. (1 April 2017). https://obsproject.com/.

32. VB Audio Software. 2017b. Voicemeeter. (1 April 2017). http://www.vb-audio.com/Voicemeeter/index.htm.

33. Arthur A Stone, Christine A Bachrach, Jared B Jobe, Howard S Kurtzman, and Virginia S Cain. 1999. *The science of self-report: Implications for research and practice*. Psychology Press.

34. Philip J. Walsh. 2014. Empathy, Embodiment, and the Unity of Expression. *Topoi* 33, 1 (01 Apr 2014), 215–226. DOI: http://dx.doi.org/10.1007/s11245-013-9201-z

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